



Living Long and Well in the 21st Century – Strategic Directions for Research on Aging

National Institute on Aging

Review Copy – May 15, 2007

Dear Friends:

We are pleased to share with you the following description of the NIA Strategic Directions for Research on Aging and to request your input as part of our ongoing planning process. The document is intended to outline the broad goals of the Institute and to serve as a framework for assessing and communicating progress toward those goals. We plan to use the online version of the document as an entry point for the public to access information on our activities and accomplishments, for our researcher community to identify potential areas of opportunity and partnership, and for our funders to assess the return on their investment.

We invite suggestions from members of the National Advisory Council on Aging, our Board of Scientific Counselors, members of the researcher community, medical practitioners, public health professionals, members of advocacy organizations, and others interested in helping to chart the future of research on aging. Your input will be invaluable in helping us ensure that we are focused on the most promising scientific opportunities and are addressing the concerns of our stakeholders.

We ask that you send your comments and suggestions to us at NIAPanning@mail.nih.gov no later than June 30, 2007.

Sincerely,

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DRAFT

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Introduction

The face of aging in the United States is changing dramatically. Older Americans are experiencing increasingly lower rates of disability, achieving higher levels of education, living in poverty less often, and living longer. Life expectancy nearly doubled during the 20th century, realizing a ten-fold increase in the number of Americans age 65 and older. Today, there are approximately 35 million Americans over age 65, and this number is expected to double in the next 25 years. The oldest old – people age 85 and older – constitute the fastest growing segment of the U.S. population. Currently about 4 million people, this population could top 19 million by 2050. Furthermore, living to 100 is becoming increasingly commonplace. In 1950, there were approximately 3,000 American centenarians. By 2050, there could be nearly one million. The challenge for the 21st century will be to make these added years as healthy and productive as possible and to maintain the current trend of decline in disability across all segments of the population.

Modern medicine and new insights into lifestyle and other environmental influences are allowing a growing number of people to remain healthy and socially and emotionally vital into advanced ages. As life expectancy increases, however, diseases and conditions among older people remain a concern. For example, more than half of all Americans over age 65 show evidence of osteoarthritis in at least one joint.^{*} One in every two women and one in four men over age 50 will break a bone in their lifetimes due to osteoporosis.[†] Cardiovascular disease, cancer, and diabetes remain widespread among older Americans, and 4.9 million Americans 65 and older suffer from Alzheimer's disease.[‡]

Our ability to reduce the burden of these diseases and other conditions will depend on new discoveries in the emerging science of aging. We need to explore “aging” not as a single process but rather as an intricate web of interdependent genetic, biochemical, and physiological processes, some of which are better understood than others. Scientists are working to gain new insights into these processes and their interactions and to use this knowledge to develop more effective ways to prevent, diagnose, and treat diseases and conditions of aging. Others are exploring the behavioral and social aspects of aging and the economic and societal consequences of a rapidly aging population. Their discoveries will almost certainly contribute to better health, less disability, and greater independence in later life.

The National Institute on Aging

The National Institute on Aging (NIA) leads a national scientific effort to understand the nature of aging and to extend the healthy, active years of life for all Americans. NIA's mission is to:

^{*} See “Osteoarthritis Initiative Releases First Data,” National Institute of Arthritis and Musculoskeletal and Skin Diseases, August 2006.

[†] Go to http://www.niams.nih.gov/bone/hi/ff_osteoporosis.htm for “Fast Facts on Osteoporosis” from the National Institute of Arthritis and Musculoskeletal and Skin Diseases, March 2006.

[‡] Go to http://www.alz.org/alzheimers_disease_alzheimer_statistics.asp for *Alzheimer's Disease Facts and Figures 2007* from the Alzheimer's Association. Figure compiled using data from the Rush Alzheimer's Disease Center in Chicago and the U.S. Centers for Disease Control and Prevention.

- Support and conduct biological, clinical, behavioral, social, and economic research related to the aging process and diseases associated with aging, as well as other special problems and needs of older Americans.
- Foster the development of research and physician scientists in aging.
- Communicate information about aging and advances in research on aging to health care providers, the public, and the scientific community.
 - With the overall goal of promoting the health and independence of older adults.

We carry out our mission by supporting extramural research at universities and medical centers across the United States and around the world and a vibrant intramural research program at NIA laboratories in Baltimore and Bethesda, Maryland.

This document outlines the broad goals and objectives of the Institute and provides a point of reference for setting priorities and a framework for systematically analyzing the Institute's scientific portfolio and assessing progress in achieving our mission. NIA strives to ensure that funding decisions and research initiatives address current and projected public health needs and to take full advantage of scientific and technological opportunities for advancing the field of research on aging. With constant monitoring of the health needs of our older population and regular consultation with our stakeholders, we will optimize our efforts to improve the quality of life of older people.

INSERT SIDEBAR: Risk for Several Diseases and Co-Morbidities Increases with Age

Our goals are to:

- Improve our understanding of healthy aging and disease and disability among older people. *See page 3.*
- Continue to develop and disseminate information about interventions to reduce disease and disability and improve the health and quality of life of older adults. *See page 9.*
- Improve our understanding of Alzheimer's disease, other dementias, and the aging brain. Develop drug and behavioral interventions for treating these diseases, preventing their onset and progression, and maintaining cognitive, emotional, sensory, and motor health. *See page 16.*
- Improve our understanding of the consequences of an aging society. *See page 21.*
- Improve our ability to reduce health disparities and eliminate health inequities among older adults. *See page 24.*
- Support the infrastructure and resources needed to promote high quality research. *See page 30.*

NIA is dedicated to the pursuit of these goals in support of our vision of a Nation in which people in their “golden years” enjoy robust health and independence, remain physically and mentally active, and continue to make positive contributions to their families and communities.

Research Goal A –

Improve our understanding of healthy aging and disease and disability among older people.

Aging comprises a set of dynamic biological and physiological processes and systems – interactive and independent – that result in wide variations among individuals. Aging often involves a progressive and inexorable loss of function that leads to increased vulnerability to disease and ultimately frailty and death. Many hypotheses and theories to explain this decline have been offered through the years, but none of them can by itself explain the array of physical, biological, and psychological changes that take place as people age.

NIA-supported researchers are beginning to define the link between genetics and lifespan. For example, numerous genes have been implicated in normal aging processes, in age-related pathologies and diseases, and in the longevity of several species including humans. Researchers are also identifying the interactions among genetics, environment, and lifestyle and behavioral and social factors and their influence on the initiation and progression of some diseases. Further research is needed to determine the role and interaction of these diverse factors in aging.

One of our challenges in this research is to develop a clearer understanding of the normal changes that accompany aging and distinguish them from the diseases and disabilities that are prevalent among older adults. One common thread, for example, is the process of inflammation, which leads over time to changes in cell, tissue, and organ structure and function. Inflammation may increase the susceptibility and rate of progression of age-related pathologies and may contribute to frailty, independent of overt disease. This and other risk or protective events that occur at various points, from early life on, may influence health and survival outcomes in old age.

NIA-supported research is also helping to identify lifestyle factors and health behaviors that directly influence physical, cognitive, and emotional fitness and risk of disease. Scientists are developing and refining recommendations for people of all ages regarding optimal diet, use of dietary supplements, mental stimulation, physical exercise, and other healthy practices to increase their likelihood of enjoying healthy old age. Still other researchers are looking for better ways to enhance the physical, mental, and interpersonal abilities of older people and to expand opportunities for them to achieve personal goals and contribute to society in meaningful ways. As we identify more precisely the behaviors and lifestyles that influence health and quality of life, we will be able to reinforce prevention efforts, enhance symptom management, conserve function, and improve caregiving.

To more fully understand aging processes and their relationship to disease and disability among older people, NIA will:

- A-1 Support studies on healthy aging, well being, and longevity.
- A-2 Accelerate the discovery of the causes and risk factors associated with disease and disability among older adults.
- A-3 Encourage translational research to bridge basic discovery and intervention development.

A-1 Support studies on healthy aging, well being, and longevity.

Research on the biology of aging has revolutionized our understanding of healthy aging. New findings about genetic, molecular, and cellular factors and processes that affect the course of aging are providing valuable insights about aging, longevity, and the genesis of disease. Similarly, population studies are uncovering potential risk factors such as environmental exposures, health behaviors, and the influence of co-existing conditions across the lifespan and their relationship to the progression of disease. NIA will continue research to:

- **Identify cellular and molecular factors that determine the pace of aging processes.** Researchers have identified key factors affecting the pace of aging, including the body's response to a variety of stresses, the function of the immune system, and the role of cellular senescence (deterioration of the cell) as a tumor suppression mechanism. NIA will work to identify additional factors and to elucidate the role of each of these processes in the aging human.
- **Determine how the cellular and molecular bases of changes associated with aging contribute to decreased function and increased incidence of disease.** Increasing age is most often accompanied by a significant and progressive decline in almost all physiological functions, resulting in increased susceptibility to a large number of age-related chronic diseases. Many researchers suspect that this increase in susceptibility to diseases may be due to the changes occurring as a result of the aging process itself. Therefore, manipulation of the basic processes of aging might provide an effective way of dealing with age-related diseases. We will foster comprehensive studies both in humans and in animal models to investigate the health- and disease-related effects of manipulating the process of aging at the molecular level.
- **Identify developmental, prenatal, early life, and environmental processes that affect aging, age changes, and disease.** Harmful substances can exert profound physical effects on a developing fetus, while childhood exposure to environmental agents such as infections or drugs can greatly limit adult physical and cognitive health and longevity. NIA will continue to support epidemiologic studies to identify such factors and participate in translational studies to lessen their effects in adults.

- **Understand the role of stem cells in tissue maintenance and how stem cells and their environments change with age.** Stem cells contribute to tissue development and replenishment throughout life, and aging-related changes in their properties and local environments are thought to contribute to age-related decline. Stem cells also hold potential for regenerative medicine in the aged – the replenishment of lost tissues and the repair of injured tissues. This is especially critical for older people who experience the greatest loss of strength and organ function, have the greatest risk of disease, and recover more slowly from surgery or injury. We will pursue the major challenges in regenerative medicine, which are to develop methods for mobilizing and using native stem cell pools and to improve the efficiency with which they reach the sites where they can be effective without harmful side effects. We will also foster research to create a detailed molecular and anatomical understanding of stem cells and their environments or niches.
- **Understand the influence of obesity and metabolic status in healthy aging.** We will continue to focus research on the relationships among obesity, insulin signaling, hypertension, and diabetes. We will continue studies on the efficacy of various nutritional approaches to prevent cancer, diabetes, neurodegenerative disease, and other conditions in older people. This research will also help determine whether or not general recommendations for healthy eating in young or middle age are optimal for older people.
- **Understand the sensory and motor changes associated with aging and how they lead to decreased function and increased incidence of disease.** Mobility changes in the aging adult can be age related or the precursor to more severe motor disorders. We will promote a better understanding of the underlying mechanisms of these and other age-associated changes. This research will provide the knowledge base necessary to develop interventions that optimize function and prevent disease in the later years of life.

INSERT SIDEBAR: Social Interactions Are Known To Promote Health and Well Being in Older People

- **Continue research on the impact of social relationships on health and well being.** Although it is well established that good social relationships are health protective, we must improve our understanding of the mechanisms and pathways through which social ties improve health. We also must better identify the characteristics of social relationships and social environments that promote healthy aging. NIA-supported research to deepen our understanding of these relationships will aid in tailoring interventions to improve the health and quality of life of older adults

- **Identify and explore the interplay among the pathways linking genetic, biological, clinical, social, economic, psychological, and environmental factors to aging and longevity.** Evidence suggests that these factors and their interplay are critical to minimizing disease and achieving full potential and vitality in later years. More research is needed to verify the linkages and to better understand their underlying mechanisms.
 - *Expand our knowledge of age- and longevity-associated genes as well as epigenetic alterations that affect longevity and well being, including modes of action.* NIA-supported research has shown that patterns of extreme longevity run in families. Furthermore, scientists have identified approximately 100 different genes that affect longevity in model organisms, including some in primates. We will continue work to identify the biological functions of longevity genes and to better understand the mechanisms of action of known and yet to be identified longevity genes (longevity assurance genes). This research will facilitate the development of biologically based interventions to promote longevity, delay age-related dysfunction, extend health span, and improve the quality of life of older people.

Epigenetic alterations (gene modifications other than changes in the DNA sequence) are also likely to play important roles in rates of aging, age-related dysfunctions, and development of age-related diseases. Like changes to the DNA sequence itself, epigenetic modifications can be inherited. These modifications affect the interaction of genes with the cellular machinery responsible for turning genes “on” or “off,” allowing or preventing them from functioning optimally. Environmental agents such as chemicals or dietary components can also modify DNA and can be transmitted to offspring.

INSERT SIDEBAR: Our Genetics Are Key Factors in How We Age

- *Identify factors across the lifespan that contribute to exceptional health or its decline.* The study of groups of older individuals is shedding light on both the biological and behavioral factors associated with healthy aging. We will continue research that links laboratory and longitudinal population-based studies, providing insights into the factors that define resilient individuals and contribute to well being in old age.
- *Refine our understanding of interplay among the biological, social, emotional, cognitive, and functional changes associated with normal aging.* The impact of changes in emotional, cognitive, and physical capacities at different life stages – in combination with life course changes in motivation and goals – on social and economic behaviors at different life stages remains unknown. We know even less about changes in the neurobiological underpinnings of these interactions. NIA will use the approaches of social neuroscience and neuroeconomics to study how the neurobiological changes associated with aging influence or are influenced by social, emotional, cognitive, and

motivational factors.

- *Elucidate the biological mechanisms and pathways through which social, psychological, and environmental stresses contribute to declines in health and well being among older adults.* Individual differences in the subjective experience and physiological impact of stressors may exacerbate or buffer the impact of stressors on health. We will encourage multi-level and interdisciplinary research on the interactive effects of genes, behavior, and social environments on health and well being in aging.

A-2 Accelerate the discovery of the causes and risk factors associated with disease and disability among older adults.

To develop new interventions for the prevention, early detection and diagnosis, and treatment of aging-related diseases, disorders, and disabilities, we must first understand their causes and the factors that place people at increased risk for their initiation and progression. NIA will continue research to:

- **Identify the genetic and epigenetic bases of age-related diseases and conditions as well as factors that affect disease initiation and progression.** Studies of genes associated with aging processes, longevity, and age-related diseases will continue to provide insights into disease pathologies and vulnerability. Research in animals and models suggests that genetic differences can account not only for differences in longevity, but also for susceptibility to a variety of age-related diseases. Therefore, we will pursue research to understand the basic mechanisms influencing the aging process as a whole. We will work to understand the interplay among genes and environmental influences, as this knowledge will be essential to our understanding of the development of both disease and healthy aging.
- **Improve our understanding of the molecular, genetic, cellular, and tissue bases of aging that contribute to increased risk for, alter the course of, and vary the response to the treatment of major age-associated diseases.** We will increase efforts to understand the genetic and epigenetic factors that can alter susceptibility of individuals to disease and affect the response to treatment. In addition, we will study how phenomena such as anxiety and other negative emotions can alter the synthesis of neurotransmitters – messengers of the nervous system – and hormones. Although these agents aid the body in responding to dangerous or stressful situations, they can damage cells, tissues, and organ systems when produced in excess.
- **Identify the molecular and cellular bases of age-related decline in immune responses.** The age-related decrease in the adaptive immune response (that is, the cellular response for manufacturing antibodies and killing pathogens) makes older people more prone to a variety of infectious agents and reduces the efficacy of newly acquired vaccinations. These factors have a significant effect on the health span and quality of life of older people. We will support research to develop more protective vaccine regimens and strategies to improve immune responses in this population.

- **Improve our understanding of how the inflammatory process is affected by aging and how these changes impact tissue function.** The degree to which primary age-related changes in inflammation contribute to changes in structure and function of various tissues and organs as well as the risk or progression of age-related pathologies and conditions is not clear. Likewise, researchers are continuing to identify the sources of pro-inflammatory cytokines. We will help determine the role played by different cell types, including immune cells and adipose tissue (fat), in the increased levels of pro-inflammatory cytokines. We will also investigate how changes in the circulating levels of these cytokines contribute to pathological changes in tissues and organs. We will facilitate exploration of how the response of different tissues to pro-inflammatory cytokines is affected by age, and how these changes contribute to the overall balance of the immune system.

INSERT SIDEBAR: Inflammation Plays a Key Role in the Aging Process

- **Identify, analyze, and track changing patterns of disability for older adults and better understand factors contributing to these patterns.** The current pattern of increased “active life expectancy,” the average number of years an individual will live without a limiting disease or disability in parallel with increased length of life is threatened by increases in obesity and in disability rates for younger cohorts. NIA-supported research will address disability dynamics at several levels, including longitudinal research to understand the determinants of onset, severity, and recovery from disabling conditions. At the population level, we will foster research to understand the pathways to disability and the causes of change in mobility and function over time as well as subgroup disparities. We will also invest in research on more sensitive measures of functional disability that are needed to better track these changes.

A-3 Encourage translational research to bridge basic discovery and intervention development.

Translational research provides the two-way bridge necessary to link scientific discoveries with applications in medical practice and public health. For research on aging, basic discoveries typically begin with studies at a molecular or cellular level to understand the mechanisms of normal aging and disease or with studies to better understand the basic behavioral and social science related to aging processes. New knowledge gained at “the bench” takes a variety of paths to human intervention studies – the “bedside.” Equally important is providing a clear path back to the bench for insights gained at the bedside. Several NIH initiatives are focusing on the

broad issues of culture change required for the biomedical community to more successfully support translational activities. NIA will continue to:

- **Identify and optimize opportunities for moving new knowledge from basic discovery to intervention development.** We will accelerate our efforts to promote promising preclinical studies and health systems research. We will also work to ensure that the advanced technologies and other resources needed for effective translational research are accessible to NIA-supported scientists.
- **Facilitate communication among NIA-supported researchers and reward interdisciplinary collaboration.** The complexity of contemporary science demands a synergistic approach to ensure collaboration among researchers from multiple scientific disciplines along the continuum of research. We will invest in multidisciplinary research programs and provide supplemental funding to support promising interdisciplinary endeavors.
- **Foster communication and partnerships with other NIH institutes and centers and with other federal agencies as well as other national and international research organizations.** NIA will continue to collaborate with other NIH Institutes and Centers on projects with a multidisciplinary focus such as the NIH Roadmap and Neuroscience Blueprint. We will continue to participate in partnerships with outside organizations to share resources, support collaborative research, eliminate barriers to drug development, and communicate research findings with public policy implications.

Research Goal B – Continue to develop, and disseminate information about, interventions to reduce disability and improve the health and quality of life of older adults.

Modern medicine and new insights into lifestyle and other environmental influences promise to have a profound impact on the health and well being of older people and make it possible for them to remain physically healthy and cognitively and emotionally vital into very advanced ages – ideally, for as long as they live. Capitalizing on new insights from basic research, NIA-supported scientists will continue to work from multiple perspectives to develop and test strategies for preempting or reducing the severity of health problems in older people. We will work to strengthen the translation of basic findings in the laboratory into practical applications to improve the health and quality of life of older adults.

Our success will depend on progress in achieving three objectives in this area:

- B-1 Develop interventions to maintain health and function and prevent or reduce the burden of age-related diseases, disorders, and disabilities.
- B-2 Understand and develop strategies to enhance societal roles and interpersonal support for older adults, reduce social isolation, and prevent elder abuse.
- B-3 Increase awareness and promote adoption of interventions to improve the health and

quality of life of older people.

B-1 Develop effective interventions to maintain health and function and prevent or reduce the burden of age-related diseases, disorders, and disabilities.

Achieving and maintaining health and function in advanced years can be aided by physical fitness, proper nutrition, and avoidance of smoking and other behaviors that adversely affect health. Conversely, unhealthy lifestyle choices may be associated with significant health problems. However, research has shown that it is almost never too late to decrease risk of disease and disability by establishing healthier patterns. Improved health habits can help people survive longer, enable them to postpone the onset of disability, and increase quality of life and function at older ages. Research has also shown that optimizing both the physical and social environment is important to the health and functioning of older people.

NIA will continue to:

- **Develop efficacious and cost effective strategies for promoting healthy and safe behaviors among older adults.**
 - *Build on our understanding of the roles of nutrition, obesity, and metabolic status to develop more effective interventions.* Epidemiological studies and in some cases, studies in animals have shown clear positive effects of manipulations such as dietary restriction and negative effects of obesity on health and age-related morbidity. We will use these and other findings to develop and test in clinical trials cost effective dietary measures for the prevention or delay of disease and disability.
 - *Use our increased understanding of exercise physiology and other branches of basic science to maximize the positive effect of exercise on older people.* Several studies strongly suggest that modest exercise may have beneficial effects in maintaining health – including mental health – and that these benefits are possible even at advanced ages. We will support further research to validate exercise and exercise programs and their effects on older people within specific age groups.
 - *Continue research to understand hormone changes in older people and pursue the development of interventions to address these changes without unwanted side effects.* Counteracting some effects of aging by supplementing hormones such as estrogen, testosterone, human growth hormone, melatonin, and DHEA (dehydroepiandrosterone) is an area of active study, but there are concerns that individuals may be taking such agents before their safety and efficacy have been established. We support studies to understand the biologic action of hormonal changes in older men and women, assess whether or not hormone therapy will improve health, investigate the use of compounds to produce the beneficial responses of hormones in the body without detrimental side effects, and determine the potential to regulate hormone production in specific body tissues where increased or decreased amounts of these hormones are favorable to health.
 - *Develop strategies to reduce falls and their consequences.* NIA-supported human factors research will continue to identify safety risks for older people in home and work environments, improve screening strategies, and develop and disseminate information

important to reducing the risk of falls.

- *Explore new ways to improve safety in the home and community through studies of ergonomics and the built environment.* We will continue to support research to identify cost-effective alterations in design that can reduce injuries and provide a safer, more secure environment for older adults.
- *Better understand needs and develop interventions to improve the safety of older drivers.* We will continue research to identify factors such as visual impairment, hearing, attention, speed of processing, and other cognitive changes that put older drivers at risk of automobile accidents. In addition, we will continue to support the development of tools for assessing visual, cognitive, and other abilities associated with safe driving, interventions to improve the physical and cognitive skills necessary for safe driving, and technology to support the special needs of older drivers. We will also support research to understand the dynamics of making the decision to stop driving and the implications of that decision for the health and well being of older people. This research will provide the insights needed to develop guidelines for older adults, their health care providers, and family members.
- *Improve the safe use of medications by older adults.* Managing medications can be complex for older people, many of whom take drugs, often prescribed by more than one physician, for multiple health problems. Complications include adverse drug interactions and interactions with dietary supplements coupled with the physiological and functional changes associated with aging or age-related diseases. NIA-supported research will improve our understanding and maximize the effectiveness of medications, develop new technical aids for physicians to monitor drug use, and provide new technologies and information to enable patients to better manage drugs and avoid adverse reactions.
- **Develop interventions for treating, preventing, or delaying the onset of age-related diseases.**
 - *Support research into the mechanisms by which lifestyle interventions affect aging-related changes and determine how individuals can maintain function with age or regain that function after loss due to immobility, illness, or trauma.* After peaking during adulthood, most tissue functions decline with advancing age. This leads to increased risks for developing diseases such as cardiovascular disease and cancer and may lead to declines in overall health and quality of life. Further research is needed on the mechanisms through which common interventions, both medical and behavioral, may slow physical and cognitive decline. NIA will continue to support research into the mechanisms of functional decline and its delay, with the goals of identifying molecular targets for drug interventions and treatments that minimize losses and promote the recovery of function after illness or trauma.
 - *Test compounds that hold the promise of increasing healthy lifespan.* Promising compounds must undergo preclinical safety and efficacy testing using animal and cellular models before being tested in full-scale clinical trials. We will continue to support the testing of promising compounds in mice and other model systems with the long-term goal of selecting for further development those most likely to have a beneficial effect in humans.

- *Conduct clinical studies and encourage the translation of new interventions to the clinical setting.* As pathways and processes of disease are better defined, basic research findings can be translated expeditiously to the development of clinical applications. We will continue to support clinical studies to improve health and well being through better treatments for age-related diseases and conditions and to test the effects of hormone therapy, dietary supplementation, and exercise and fitness. We will work with others to facilitate the navigation of barriers to the translation of promising compounds into clinical trials and ultimately approval by the U.S. Food and Drug Administration.
- **Develop improved approaches for the early detection and diagnosis of disabling illnesses and age-related debilitating conditions.** We will help develop and evaluate improved techniques and tools to measure the well being of older people as well as symptoms of disease and disability. As new interventions are ready, we will facilitate the movement of imaging and other technologies into mainstream medical practice where they can be used routinely to assist in early detection and diagnosis as well as to monitor the efficacy of interventions tested in clinical trials.
- **Find significantly improved and cost effective ways to reduce caregiver, family, and patient stress and improve older people's ability to cope with chronic disease.** Families and others who care for people with chronic disease frequently face emotional stress as well as physical and financial burdens. Investigators will continue to evaluate strategies to improve social support, skills training, and assistive services both for those who cope with chronic disease and for their caregivers. NIA-supported research will clarify needs and patterns of family caregiving and how people make decisions on providing care and inform guidance on support and skills, including a focus on families with diverse ethnic and socioeconomic backgrounds.
- **Develop strategies to improve the interaction of older people with the health system.** For older adults and their families, good health care requires quality communication with and among the physician and other health care professionals. According to one study, fewer than 40 percent of people experiencing symptoms associated with heart and circulation or musculoskeletal systems seek a physician's care. Similarly, women often avoid seeking care for urinary incontinence. NIA will help develop strategies to assist patients in dealing with multiple services and to manage health care financing for multiple chronic conditions. We will seek better interventions to help older people recognize the implications of disease-related signs and symptoms and consult a physician or other health care provider when they first occur. And we will work to find ways to help health care providers coordinate their services to older adults.

B-2 Understand and develop strategies to enhance societal roles and interpersonal support for older adults, reduce social isolation, and prevent elder abuse.

Despite negative stereotypes, millions of older people work productively and otherwise contribute to society and place a high value on retaining their independence. Research suggests that social support and continued involvement in useful activities foster positive effects both on

physical and mental health and on longevity. This effort is especially important for older adults who are at increased risk for multiple diseases, disability, and functional limitations that may keep them from fully engaging in the world around them. Improvements in acute and long-term health care for older people are also essential, including strategies to ease the burdens of caregivers and enhance quality of care at home and in different long-term care settings. These initiatives should result in more effective approaches for prevention, treatment, and rehabilitation.

NIA will continue to:

- **Identify ways for older people to retain valued roles and maintain independence.** Older men and women are now working in paid jobs, doing essential volunteer work, maintaining a household, and/or supporting children and grandchildren. NIA-supported research will seek and apply technological, social, and behavioral findings to extend older people's ability to remain independent, active, and productive in later life.
- **Conduct research on the social and economic aspects of family caregiving and develop and disseminate effective interventions for patient care in family and community settings.** Intergenerational family support is the most common way in which a family assembles and allocates its resources of money, skills, and time to care for all its members.
 - *Assess and evaluate family relationships over time.* This research will help us understand the effects of changing relationships on the health and well being of older people, and gain insight into the caregiving, emotional support, and family level economic aspects of aging.
 - *Address issues centered on the increased demands faced by family caregivers in light of changing patterns of work and family demographics.* We will pay particular attention to the ways in which characteristics such as gender, marital status, income, socioeconomic status, race, and ethnicity influence these demands.
- **Develop strategies to help older people and their families prepare for and manage age-associated changes in health, income, function, and roles.** Older adults and family members are faced with many complex decisions about retirement, finances, health and life insurance, and medical treatment. Issues of concern include the ability of health care delivery systems to support patient and family needs and adherence to a patient's advanced directives. NIA-supported research will inform decisions about complex issues of health, finances, and family in late life, both for individuals and policymakers.
 - *Compile up-to-date information about patterns of work and retirement, sources of retirement income, intergenerational income transfers, and status of health and disability at the regional, national, and global levels.*
 - *Use that information to develop and make available information and other resources for people as they plan for later life transitions and possible loss of independence.*

- **Research and develop strategies to improve decision making for long-term and end-of-life care.** There is a pressing need to define organizational mechanisms that will ensure quality, affordable health care for older people. There is also a critical lack of empirically generated knowledge on how to maximize quality at the end of life. Medical culture is oriented primarily to patient care and not to addressing the multifaceted needs of dying patients and their families. To better address these issues, we will:
 - *Examine component parts of health care delivery systems and their impact on medical, social, functional, and cost outcomes and use this information to develop interventions to improve care.* This research will help inform the development of interventions to coordinate care that promotes attention to patient and family preferences, facilitates smooth transitions among care settings, and maximizes independence. We will explore ways to support long-term care, most often provided in a home setting. We will focus on interventions that reduce the burdens of caregivers, with an emphasis on the unique challenges faced by dementia patients and their caregivers.
 - *Understand caregiving patterns and improve the effectiveness of different strategies for helping families manage the care needs of the physically frail.* For example, we will use knowledge gained from this research to develop specific guidance on caregiving skills, environmental modifications, and technological supports for both informal and formal long-term care settings.
 - *Assess the impact of health care organizations and provider interactions on the quality of life for dying individuals.* Special attention will be given to developing strategies that enhance support of the older person, the family, and medical care providers who are attempting to provide humane and life-affirming services at the end of life.
 - *Develop strategies to improve the experience of older people at the end of life.* We will support research to better understand the decision making process and changing preferences associated with advance care planning; better understand the transitions among end-of-life care settings such as the home, hospital, nursing home, and hospice; assess the benefit of end-of-life therapies and the cost-effectiveness of interventions to improve end-of-life care; develop better measures of end-of-life quality for the patient and the family to improve our understanding of psychosocial issues that impact the end-of-life experience; and understand the social and economic context of caring for an older person who is dying.
- **Understand and develop strategies to address elder neglect and abuse.** Although isolated studies have documented the devastating long-term consequences of elder mistreatment, research on elder neglect and abuse has been inadequate. We will support research to determine the prevalence of elder neglect and abuse. And we will work to develop and disseminate for use by health care professionals reliable measurement tools for assessing neglect and abuse and interventions to reduce its incidence.

B-3 Increase awareness and promote adoption of interventions to improve the health and quality of life of older people.

Communication efforts play a critical role in educating the public about research advances to improve health and well being in later life. Health communication activities can increase the public's awareness of a specific aging issue, problem, or solution; reinforce certain knowledge, attitudes, or health behaviors; and encourage individual or collective action. Health education programs, activities, and materials also can inform, influence, and motivate the public.

Communicating effectively about health is challenging. Health information is often complex and technical. Moreover, the information may be inconclusive, controversial, contradictory, or subject to change as new research findings are released. Health information also may conflict with long held personal beliefs. To succeed, health communication programs and materials must be based on an appreciation of the needs and interests of the target audience. Large scale, multi-year, multi-media efforts may be needed to inform, persuade, convince, and sustain behavior change. To address these concerns and ensure that research results are disseminated to all who need them, NIA will:

- **Develop, test, and conduct health communication programs and outreach activities to inform the public about the interventions and health-related progress validated by the results of research on aging.** We will craft and deliver messages and materials based on research to understand how the target audience perceives and reacts to health messages, how the public is persuaded to change behavior, and how people in general, and older people in particular, respond to various media.

INSERT SIDEBAR: Some Things We Know for Sure: Ten Ways to Stay Healthy

- **Develop culturally appropriate materials and programs for a variety of target audiences.** We will continue to work to overcome cultural and language barriers to the effective communication of health information.
- **Explore successful networks for the transfer of research knowledge and evaluate the usefulness of transferred interventions for older adults in broadly designed and applied outcomes research.** NIA will continue to work with other federal agencies, state and local governments, and the private and non-profit sectors to ensure that results of research on behavioral and community interventions are widely shared and have an impact on policies and programs.

Research Goal C –

Improve our understanding of Alzheimer’s disease (AD) and other dementias of aging and the aging brain. Develop drug and behavioral interventions for treating the diseases, preventing their onset and progression, and maintaining cognitive, emotional, motor, and sensory health.

Better understanding of how the brain ages will provide important information on which to base strategies for maintaining and enhancing cognitive, emotional, motor, and sensory function through biological and behavioral interventions. For example, studies have shown that new neurons form in certain regions of the brain even in adulthood. This phenomenon, known as neurogenesis, suggests that medical and behavioral approaches could be found to stimulate the formation of new neurons to compensate for the loss and functional decline of neurons with aging, disease, or traumatic injury. NIA will support research to harness functional imaging and other advanced technologies that view activity in specific regions of the brain to identify age-related neural changes and mechanisms the older brain uses to maintain optimal learning, memory, and other cognitive functions. We will also work to clarify the interactions between the brain and the peripheral nervous, endocrine, and immune systems. And we will support the development of preventive and therapeutic approaches to maintaining health in cognition, emotion, sleep function, sensory processes, and motor function. Research on the function of the normal brain and peripheral nervous system will help us understand the ways in which non-dementia related health outcomes arise.

Our objectives in this area are to:

- C-1 Understand the mechanisms involved in normal brain aging; the role of cognition in everyday functioning; protective factors for sensory, motor, emotional and cognitive function; and the pathogenesis of AD and other neurodegenerative disorders of aging.
- C-2 Develop better ways of distinguishing people with normal brain aging from those who will develop mild cognitive impairment, AD, and related conditions.
- C-3 Translate the discoveries about the cellular and molecular mechanisms of cognitive, emotional, sensory, and motor function with age and the mechanisms of AD pathogenesis into treatment and prevention strategies.
- C-4 Conduct research to better understand and develop interventions to address the special caregiving needs of patients with AD and other dementias.

C-1 Understand the mechanisms involved in normal brain aging; the role of cognition in everyday functioning; protective factors for sensory, motor, emotional and cognitive function; and the pathogenesis of AD and other neurodegenerative disorders of aging.

NIA will continue research to:

- **Improve our understanding of nervous system and behavioral changes that occur with normal aging and how brain function is maintained and enhanced.** Recent research shows that the hippocampus, a region of the brain important for acquiring and processing information, is capable of generating new nerve cells. Furthermore, research in mice demonstrates that increased physical and mental activity started in “middle age” can increase hippocampal neurogenesis and decrease signs of neuronal aging. This suggests that neurogenesis may be one factor underlying the beneficial effects of an active lifestyle on brain integrity and behavioral function in humans. We will continue to explore the role of exercise in promoting healthy cognitive, emotional, and motor functioning and in activating the cellular machineries that protect the brain from damage and promote its repair. This research will help form the basis for future investigation of more subtle neural changes that occur with age, including selective neuronal loss or dysfunction that impacts memory and other functions, impaired neuronal connections, early brain atrophy, and changes in the responses of glial cells involved in neuron survival and brain plasticity and possibly inflammation.
- **Determine how genetic, molecular, cellular, and environmental factors interact for optimal brain health and functioning, including in the oldest old.** The overall integrity of brain structure and many neural systems are largely preserved in normal aging, while in age-related diseases, specific brain cell types are damaged or lost. Evidence suggests that achieving the full potential of the central and peripheral nervous systems depends on developing the brain optimally in early life, continuing activity to maintain function in midlife, and stimulating the brain to compensate for cell death and injury in older age. We will work to gain a greater understanding of the many factors that interact to maintain brain function. This research will enhance our understanding of, and potentially our ability to prevent, brain function decline in aging and disease. For example, we will:
 - *Continue to pursue a greater understanding of the interaction among genetic factors that underlie normal cognitive, emotional, sensory, and motor function as well as abnormal decline and the interactions between genetics and the environment.*
 - *Investigate epigenetic changes, which can significantly influence their structure and function within the cell.*
 - *Support research to better understand the neurological and behavioral effects of environmental factors, both early and later in life.*

In addition, we will continue to investigate the changes in brain function that take place in the “oldest old,” people 85 and older. In the absence of disease, many of these individuals, who represent the fastest growing segment of the U.S. population, continue to lead healthy

and productive lives even into unusually old age. Others, however, suffer from health conditions that together contribute to cognitive decline and dementia. We will work to identify and address the conditions that most affect brain health in this group in order to find ways to maintain function as long as possible.

INSERT SIDEBAR: We Must Distinguish Normal Brain Aging from Mild Cognitive Impairment and Dementia

- **Understand the role of cognition in everyday functioning, including work environments, decision making, and interaction with technology.** NIA will support research to examine the influence of contexts – behavioral, social, cultural, and technological – on the cognitive functioning of older adults; investigate the effects of age-related changes in cognition on activities of daily living, social relationships, and health status; and develop strategies for improving everyday functioning through cognitive interventions.
- **Explore possible additional risk and protective factors for brain health and function, cognitive decline, mild cognitive impairment (MCI), and AD through epidemiologic and other population studies.** Community-based studies of aging and AD are becoming progressively more sophisticated. Traditional interviews, clinical evaluations, and routine laboratory tests are increasingly complemented by advanced imaging and other technologies to identify risk factors and protective factors and to relate them to specific biologic mechanisms. NIA will place a special emphasis on community-based studies, including studies in racial and ethnic minority populations, capable of linking early life or mid-life factors with late-life cognitive decline or impairment. We will include studies of the ways that multiple factors, such as lifestyle and genetics, interact to cause disease or contribute to cognitive decline.
- **Refine our knowledge of molecular, cellular, cognitive, and other behavioral changes that cause or accompany development of AD and other dementias of aging.** We will investigate the multiple pathologic changes associated with the development of AD, including the death of neurons and the accumulation of abnormal proteins. We will promote further characterization of these pathologic changes in tissue culture, animal models, and humans. This research will enhance our basic knowledge of altered neural, cognitive, and behavioral function in older adults and will aid in the development of appropriate treatments.
- **Investigate the relationship of systemic metabolism and diseases to brain and/or behavioral functioning.** Epidemiological research has shown that metabolic and vascular risk factors such as diabetes, hypertension, heart disease, and current smoking may be associated with accelerated age-related cognitive decline and with increased risk for AD.

This association is even more pronounced in individuals with three or more vascular risk factors. We will support research to determine if these risk factors can be counteracted through behavioral and lifestyle changes. We will explore the possibility that brain-body interactions represent a two-way paradigm. In other words, not only do systemic factors contribute to cognitive decline, but cognitive impairments and brain aging may also lead to chronic systemic conditions. For example, chronic sleep restriction has been associated with hormonal and metabolic changes that may lead to obesity, diabetes, hypertension, increased cardiovascular disease, or cognitive decline.

C-2 Develop better ways of distinguishing people with normal brain aging from those who will develop MCI, AD, and related conditions.

Successfully distinguishing people who are aging normally from those who will develop MCI – often a precursor to AD – and AD itself is critical to promoting healthy aging behaviors and the prevention, early detection and diagnosis, and treatment of disease. Identification of biomarkers of the transition from normal function to different levels of cognitive impairment is facilitating our efforts. NIA will work to:

- **Improve neuropsychological assessment of cognitive function.** Despite remarkable advances in neuroimaging, neuropsychological assessment of cognitive function continues to be the gold standard by which AD is diagnosed. We will continue to support development of better tools for assessing cognitive function both in the clinic and in the home environment. In one recent project, NIA helped establish the Uniform Data Set (UDS), comprising both clinical and neuropsychological tests, across all Alzheimer's Disease Research Centers (ADRCs) in the United States. The UDS will promote uniformity in collection of cognitive function data and will allow researchers to pool large sets of data across ADRCs. We will also participate in plans outlined by the recently funded NIH Neuroscience Blueprint Toolbox project to develop a measurement tool that includes a module for assessing cognitive, sensory, motor, and emotional function in adults. A standardized assessment tool of this type will help researchers track and compare behavioral change over time in longitudinal and epidemiological studies and in clinical trials.
- **Improve methods of assessing changes in sensory and motor systems as markers of age-related change and AD.** Age-related changes in sensory systems occur in both normal individuals and those with AD. We will continue to examine how the use of sensory testing to predict early neurodegeneration could assist in clinical diagnoses. We will also continue research to explore possible correlations between changes in sensory perception and AD. For example, we will investigate how changes in a person's ability to visually navigate through the environment or changes in a person's sense of smell may predict the development of AD.
- **Identify neuroimaging and other biological markers for early detection of cognitive decline, MCI, and AD and for understanding the progression from normal cognitive aging to MCI to early AD.** Biomarkers may be helpful in earlier and more accurate diagnosis of disease and in tracking disease progression and treatment response in clinical trials, which can decrease the time and cost of trials.

C-3 Translate discoveries about the cellular and molecular mechanisms of cognitive, emotional, sensory, and motor function with age and the mechanisms of AD pathogenesis into treatment and/or prevention strategies.

NIA-supported studies have combined both cognitive training and standard drug treatments such as donepezil to improve memory in patients with dementia. Other NIA-supported trials focus on slowing the progression of cognitive symptoms in dementia. Still others focus on preventing the early stages of cognitive decline. We will continue efforts to accelerate translational science to apply the basic science findings on brain mechanisms in healthy aging and disease to the identification and testing of new prevention and treatment strategies.

NIA will continue to:

- **Stimulate translational research.** We will emphasize translational research for drugs and behavioral interventions aimed at maintaining brain and behavioral health and functioning. We will apply what we are learning about the interplay among biological, behavioral, and social factors to develop more targeted and effective interventions.
- **Support clinical trials for drug and behavioral interventions to prevent, treat, and delay the onset and progression of cognitive decline, MCI, AD, and other dementias.** We will continue to test promising new drug, behavioral, or combination interventions in clinical trials with the intention of moving them rapidly into medical practice.

C-4 Conduct research to better understand and develop interventions to address the special caregiving needs of patients with AD and other dementias.

A number of recent studies have demonstrated that the chronic stresses of caring for a family member with dementia can cause lasting psychological and even physical consequences. Research has shown that these caregivers have an increased risk of depression, elevated stress hormones, increased vulnerability to influenza, and poor wound healing (in the older caregivers). NIA will continue to:

- **Conduct research on the family and economic burdens of AD and other dementias.** Formal and informal care for older persons with dementia is a major cost for families, private insurers, and the public sector. We will support research at several levels, including studies on the mechanisms through which the stress of caregiving affects health. We will work with others to develop new types of interventions for alleviating the stress. Other studies will help us quantify and understand the economic burdens to inform health policy decisions.
- **Develop better strategies for the care of patients with MCI and AD and for alleviating caregiver burden.** NIA-supported investigators have developed a multifaceted, personalized intervention that can significantly improve the quality of life for caregivers of people with dementia. We will continue to develop and test other interventions of this type. In addition, we will research the needs of long-term spousal caregivers following the death of their spouses and support development of post-bereavement interventions aimed at providing social support and working through the persistent traumatic and stressful thoughts of the

prior years of caregiving.

Research Goal D –

Improve our understanding of the consequences of an aging society.

The greater longevity and improved health seen at older ages in many parts of the world represent one of the crowning achievements of the last century, but also present a significant challenge. Societal aging may affect economic growth, patterns of work and retirement, the way families function, the ability of governments and communities to provide adequate resources for older people, and the prevalence of chronic disease and disability.

NIA will continue to support research on the social, economic, and demographic consequences of the rapidly aging population in the United States and other countries. In addition, we will continue to support research on how social and economic factors across the lifespan affect health and well being during old age.

NIA objectives in this area are to:

- D-1 Understand how population aging and changes in social, economic, and demographic characteristics of cohorts reaching old age affect health and well being in the United States and other countries.
- D-2 Understand how social, economic, and health system factors produce disparities in health at older ages and develop interventions to reduce disparities.
- D-3 Understand how social and economic factors throughout the lifespan affect health and well being at older ages.

D-1 Understand how population aging and changes in social, economic, and demographic characteristics of cohorts reaching old age affect health and well being in the United States and other countries.

The social, economic, and demographic changes the Nation is experiencing at the population level may have profound effects on health and well being at the individual level. For example, changes in family structure may lead to changing trends in family caregiving practices, chronic diseases of aging may become more common, and the health care system may experience strain as greater numbers of Americans require services.

NIA will continue to:

- **Explore the effect of education and other social and demographic factors on health and well being at older ages.** Educational attainment is one of the strongest correlates of physical health and cognitive functioning at older ages. We will support research to unravel the reasons for this connection to help project health and long-term care needs and devise ways to intervene to reduce disparities.

- **Assess the impact of changing family structures on health and caregiving.** Changing family structures mean that people now approaching old age are more likely than their predecessors to be divorced, childless, or in stepfamilies. We will support research on the ways in which the evolution of the American family structure will affect the well being of the elderly by influencing living arrangements, caregiving, and economic support.
- **Encourage comparative analyses to evaluate the impact of institutions on population and individual well being and foster longitudinal studies on aging.** Other countries have larger proportions of their populations now at older ages than the United States, and many of those with currently younger populations are “aging” at a much more rapid rate. A wide variety of institutional arrangements for income support, home health care, long-term care, and acute care have been developed in response to the challenges of population aging. We will support comparative research on the effects of these changes on behavior and will evaluate institutional reform efforts to gain insights useful both in the United States and elsewhere.

INSERT SIDEBAR: Understanding Disability Trends Will Help Us Address Them

- **Examine the bases for individual and societal attitudes toward older people and develop effective strategies to improve them.** Older people may be the target of inaccurate and negative stereotypes. We will support research to explore the causes of these negative attitudes and develop strategies to counter them with community and other interventions. For example, engaging older people in meaningful volunteer work may prove to be a "win-win" situation for society, replacing the image of dependence with one of active and productive citizens.

D-2 Understand how social, economic, and health system factors produce disparities in health at older ages and develop interventions to reduce disparities.

Health disparities continue to exist among different racial, ethnic, and socioeconomic groups. Research is needed to understand the causes of these disparities and how they relate to social, economic, and health system factors and develop interventions to reduce the disparities. NIA will continue to:

- **Encourage cross-national comparative and historic research as an approach to understanding the burden of disease and health disparities.** In a world increasingly united by trans-national families, travel, migration, and trade, we will work to connect research on health disparities with the global research community to meet the increasingly difficult challenges faced by researchers both within and outside of the United States.
- **Encourage interdisciplinary biodemographic, health systems, social, and economic perspectives to understand gender differences in health at older ages.** Recent demographic and economic trends have gender-specific implications for health and well being at older ages. Non-married women, for example, are less likely than non-married men to have accumulated assets and pension wealth for use in older age, and older men are less likely to form and maintain supportive social networks. We will support research to explain how these and other factors may contribute to the differences in life expectancy and disability rates among men and women at older ages. This research will inform development of targeted policies to achieve dual goals of increasing longevity and delaying the onset and severity of disability.

D-3 Understand how social and economic factors throughout the lifespan affect health and well being at older ages.

Individual differences in chances for a healthy and secure old age emerge in mid-life. For example, NIA-supported research indicates that Americans in late middle age have much wider variation in wealth (i.e., total accumulated assets) than in current income (i.e., earnings). Furthermore, work and other decisions by people in their 50s and 60s are already affected by chronic conditions and disability. NIA-supported research will focus on both observational studies and interventions to improve function based on a life course perspective.

We will continue to:

- **Support research on social insurance and health insurance systems (e.g., Social Security and Medicare) to assist other agencies in promoting the health and well being of the elderly while assuring program efficiency.** As record numbers of Americans reach retirement age, “entitlement” programs such as Social Security and Medicare will face unprecedented challenges. We will support research to assist these and related programs to work as effectively and efficiently as possible to safeguard the health and well being of older Americans. Our studies on the social, educational, public health, and biomedical variables that affect length of life and rates of disability, also will inform decisions related to social and health insurance systems. We will also support continued work to understand the biological, behavioral, economic, and social basis for decisions of individuals, employers, and families that affect income security in retirement and the financing of long-term care.

Research Goal E –

Improve our ability to reduce health disparities and eliminate health inequities among older adults.

During the 21st century, the United States will experience a dramatic increase in the proportion and diversity of racial and ethnic minorities in its older population. Life expectancy at older ages has increased significantly over the past 25 years for all major racial groups, but there are disparities. Socioeconomic factors such as work, education, income, and wealth can have a serious impact on health and well being. Economic circumstances can determine whether an individual can afford health care and proper nutrition from early life into old age. Individual and family financial resources and health insurance can determine whether an older adult enters a nursing home or stays at home to be cared for by family and friends.

Health disparities are associated with a broad, complex, and interrelated array of factors. Diagnosis, progression, response to treatment, caregiving, and overall quality of life may each be affected by race, ethnicity, gender, socioeconomic status (SES), age, education, occupation, and other as-yet-unknown lifetime and lifestyle differences. For example, a recent multi-ethnic epidemiologic study supported by NIA indicated that prevalence rates for Alzheimer's disease (AD) may be higher for African Americans and Hispanics than for other ethnic groups. Another study found striking relationships between SES and both health and longevity. And gender differences in health and longevity are observed across racial and ethnic groups.

We will continue to support essential research to increase our understanding of and reduce health disparities and inequities among older adults. We will support research to establish the scientific basis for redressing differences and inequities affecting older adult populations. We will work to understand the extent to which genetic, behavioral, social, and other factors that may show variation across racial and ethnic groups influence health and longevity. And we will use new knowledge to develop behavioral and public health interventions for reducing disparities and increasing quality of life for all older adults.

Our objectives in this area are to:

- E-1 Understand health differences and health inequities among older adults.
- E-2 Develop strategies to promote active life expectancy and improve the health status of older adults in minority and other underserved populations.
- E-3 Use research insights and advances to inform policy on the health, economic status, and quality of life of all older adults.

E-1 Understand health differences and health inequities among older adults.

There are many complex and interacting factors related to race, ethnicity, gender, environment, SES, geography, place of birth and recency of immigration, and culture that can affect the health and quality of life of older adults. Socioeconomic factors related to work, retirement, education, income, and wealth can have a serious impact on the health and well being of the elderly. There are also biologic and genetic factors that can affect the course and severity of disease and disability. All of these factors and their interactions must be understood in order to design effective interventions to improve health equity among various ethnic/racial and low SES population groups.

To support this objective, NIA will continue research to:

- **Understand normal aging processes across various ethnic/racial and low SES populations.** We will characterize normal processes of aging in minority and low SES populations to increase our understanding of the course of disease and disability, and to identify the similarities and differences among racial and ethnic groups and among groups living in different geographic locations.
- **Determine the effects of early life factors on adult health.** Early life events can play an important role in the aging process. Differences in nutrition, education, disease incidence, environmental exposure and health care in fetal development and early in life can affect disease and disability in later life. Because of the wide variety of racial, ethnic, and national backgrounds in minority older adult population groups, scientists can learn much about early life events and how well these individuals age. Research into the influence of early and mid-life experience on aging health will advance our ability to predict health status of future cohorts of older adults.
- **Gather data that further classify patterns of health differences, inequities, and causes.**
 - *Link data from multiple sources to assemble the necessary volume and types of information needed.* Research to understand health disparities requires data that is accessible to researchers on a national level, as well as appropriate ways to utilize multiple small data sets collected by many different researchers. NIA will support the use of “linked data” to discover new scientific knowledge and to help in the evaluation and design of policies to deal with an aging society. This approach will allow data from several sources to be linked by a common identifier and analyzed in ways not previously possible.
 - *Use ongoing data collection programs to over sample minority populations.* These data will provide important information on living arrangements, income, health care needs, and other topics.
 - *Continue to support surveys focused on specific groups and concentrated on issues of illness and well being.* NIA will continue to support and expand surveys of racial, ethnic, and language minority groups in order to provide the data needed by researchers and public policy makers.

- **Determine the influences of and interactions among race, culture, ethnicity, economic status, education, and work experiences in health.** Health and quality of life, particularly in later years, are affected by many interrelated factors. NIA will learn more about risk factors for disease and preventive factors contributing to good health by researching the influence of each factor individually and in concert with one another. We will place a special emphasis on longitudinal data, which provide information about individuals across their lifespans, to untangle the multitude of factors that affect health and well being.

E-2 Develop strategies to promote active life expectancy and improve the health status of older adults in minority and other underserved populations.

As life expectancy increases among all population groups, there are more adults living with one or more chronic conditions that may not affect the length of life but may dramatically affect quality of life. Research shows that these differences in active life expectancy are more marked among the medically underserved. Genetic, lifestyle, and socioeconomic factors also play an important role in the time of onset or severity of disease and disability. NIA's efforts to understand the special needs of minority older adults will facilitate the design of effective interventions to improve health status and quality of life for our entire aging population. NIA will continue research to:

- **Track and analyze disease prevalence and course in diverse older adult populations.**
 - *Determine the causes of disparities in the prevalence of diseases and conditions such as heart disease, obesity, hypertension, frailty, diabetes, co-morbidities, and certain types of cancer among minority and underserved populations.* For example, African Americans suffer from hypertension and prostate cancer at higher rates than their white counterparts. Hispanics suffer more from diabetes but less from heart disease. NIA-supported researchers will explore socioeconomic factors such as education, language, and access to health care, as well as how genetic, molecular, and cellular factors contribute to differences across populations.

INSERT SIDEBAR: Life Expectancy Varies Dramatically Across Populations

- *Determine the reasons for variation in the prevalence of cognitive decline and Alzheimer's disease (AD) across population groups.* We will support research to better understand the differences in the prevalence of AD among African Americans, Asians, and Hispanics compared to non-Hispanic whites. For example, Japanese Americans living in Hawaii have lower prevalence of stroke-related dementia and higher rates of AD than Japanese nationals. We will continue to examine a range of possible causes of these disparities including the impact of diseases such as hypertension, cardiovascular disease,

and diabetes; health behaviors; and disease processes in minority populations. This research will draw on culturally appropriate, equivalent, and standardized measures to better understand these differences and to suggest culturally appropriate interventions.

- **Develop appropriate health strategies for disease, illness, and disability prevention and healthy aging among the underserved.** Aging Americans all need understandable, culturally appropriate interventions they can use to maintain and improve their well being. For example, adults with low levels of education and limited fluency in English may need specially adapted assessments of cognitive function for the diagnosis of AD. Diet and exercise recommendations may need to be adjusted to take into account religious and ethnic sensitivities. Adults are more likely to use their medication appropriately if the labels and instructions are printed in their native language. To address these and other concerns, NIA will:
 - *Develop and promote culturally appropriate interventions to improve healthy behaviors along with strategies to increase the likelihood that these interventions will be initiated and maintained.*
 - *Design and promote interventions appropriate for older adults in diverse populations to more effectively prevent, diagnose, or reduce the effects of disease.*
 - *Design and promote culturally appropriate strategies for self management of chronic diseases.*
 - *Investigate the factors affecting medication misuse and culturally appropriate strategies for enhancing proper use and compliance with medication regimens.*
- **Develop interventions to improve culturally appropriate health care delivery.**
 - *Design interventions to facilitate communication between health care professionals and Asian, Hispanic, and other elderly who have come to the United States with a range of educational and language skills.* Interactions with health care professionals can be difficult if there are language and cultural barriers. If the elderly individual is hospitalized or placed in a nursing home, communication becomes a critical issue in assuring appropriate health care. NIA will increase efforts to develop evidence-based practices that will facilitate communication of symptoms and care instructions between the patient and the health care provider.
 - *Develop interventions to reduce health disparities and inequities associated with poor provider-patient interactions.* Recent studies have revealed that how older adults are diagnosed and treated is as much a function of who they are, who is treating them, and where care is provided as it is a function of the symptoms they present. NIA will investigate ways to ensure that each individual is treated with appropriate evidence-based interventions regardless of race, ethnicity, or cultural background.
- **Develop strategies to increase inclusion of minorities and other underserved populations in research.**
 - *Investigate novel approaches for increasing representation and retention of minorities in research careers.* We will work to identify the best strategies for training and attracting a diverse workforce of new, mid-career, and senior researchers for research on aging. We

will continue programs to assemble a cadre of high quality researchers through flexible training mechanisms that reflect the rapidly changing needs of science and provide cross-disciplinary training. We will work to tap the talents of all groups of society by encouraging degree-granting institutions to establish and improve programs for identifying, recruiting, and training women and men – including minorities and individuals with disabilities – for careers in biomedical science. We will work to stimulate the training of investigators who can translate the findings of basic research into medical benefits for older people and expand the pool of clinical geriatric investigators.

- *Continue to support training for clinical staff in message development, recruitment strategies, and community and media outreach.* Our ability to involve adults representative of the total population in research studies is essential to sound research and to obtaining the results needed for evidence-based intervention development. However, historically, members of minority populations have been underrepresented in clinical trials. Outreach efforts, such as involving faith-based and community organizations in emphasizing the importance of medical research and in recruiting study participants, have had varied success in minority populations. NIA will search for more effective ways to mitigate the difficulties associated with enrollment of minority individuals in research studies and clinical trials. For example, we will address cultural and language barriers and encourage effective communication of the potential benefits of studies and trials for improvement in health.
- **Develop training programs to prepare culturally proficient health care providers and biomedical researchers.** We will facilitate training of researchers and health care providers who understand the medical implications of the growing diversity of our population. These training programs will help prepare the next generation of our health workforce by incorporating new materials sensitive to these issues.
- **Conduct research to better understand effective strategies for communicating health messages that are culturally appropriate in various racial/ethnic and low SES populations.** Because of language, educational, and cultural differences, underserved groups do not always receive the information they need about healthy lifestyle behaviors. NIA-supported communication research with specific target audiences will assist the development of appropriate health messages and dissemination channels.

E-3 Use research insights and advances to inform policy for improving the health, economic status, and quality of life of all older adults.

A key resource for understanding health disparities and inequities that exist among older adults is data on trends and patterns that can explain the interaction between financial assets and health outcomes in different racial and ethnic groups and within economically disadvantaged groups. Data that increases our understanding of the role of educational status in improving health behaviors and health status will also inform the development of more effective policies.

Minority and underserved elders depend more heavily on Social Security, receive little support from private pensions, derive less income from accumulated assets, and rely to a larger extent on earnings from employment in old age. Challenges for policy makers include finding ways to

encourage individual savings and home ownership and facilitate continued employment.

To support this objective, NIA will continue to:

- **Study population changes and underlying causes of health and function of older adults across the lifespan.** Many studies have identified significant risk factors for the development of chronic diseases that pre-date onset of symptoms by at least a decade. Population-based studies in which individuals are tracked from birth and across the lifespan help researchers understand the changes in health over time and the large variations in health across racial and ethnic populations. NIA-supported research will continue to develop, maintain, and analyze longitudinal data sets.
- **Track and analyze patterns of aging and the burden of disease within and across diverse populations.**
 - *Gather and analyze data on burdens and costs of illness, healthy life expectancy, longevity, and mortality trajectories.* Determining the costs of specific illnesses has always been difficult due to the lack of adequate data on incidence and prevalence as well as inconsistencies in calculating direct and indirect medical costs. These difficulties are compounded in minority populations by differences in use of formal medical care and informal family caregiving. Projections of future active life expectancy, longevity, and mortality depend on assumptions about how groups of individuals will change over time, particularly as recent immigrants become culturally assimilated. This research will provide valuable information for projecting the specific needs for health care services within various population groups.
 - *Develop cross-national and sub-national databases on health outcomes, risk factors, and SES structural factors, such as societal inequality.* Although many of the disparities in adult health and life expectancy across national, racial, occupational, and social class boundaries are well documented, causal mechanisms are less well understood. NIA-supported research to understand these differences will be critical to the development of behavioral and public health interventions.
- **Provide information useful for policy discussion and decision making.** We will continue to collect nationally representative longitudinal data on retirement, health insurance, savings, and family variables and share this data and trends with researchers, policy analysts, and program planners. Research findings of reduced disability among the elderly have become prominent in the public policy debate regarding Medicare and Social Security. NIA will investigate whether disability is being prevented or postponed, identify contributors to disability decline, determine the impact of changes in health care, and examine the economic implications of reduced rates of disability.

Goal F –

Support the infrastructure and resources needed to promote high quality research.

The availability of the infrastructure and resources needed to support present and future research, program management, and information dissemination is critical to the NIA mission. NIA will work to provide resources to develop a skilled interdisciplinary research workforce, ensure that scientists have access to the technology and equipment they need to perform the research, and facilitate the dissemination of research results to scientists, health professionals, and the public. We will:

F-1 Continue to engage in collaborations and partnerships to create synergy, facilitate interdisciplinary exchange, and leverage resources.

- Work closely with other NIH institutes and centers, and other government agencies, to collaborate across the continuum of research from basic science through clinical studies and to disseminate information about proven interventions.
- Continue to participate in trans-NIH efforts such as the Roadmap for Biomedical Research and the Neuroscience Blueprint.
- Partner with other government agencies, professional organizations, and advocacy groups to ensure that research results are translated into public health programs and medical practice and used to inform public policy.

F-2 Train and attract a diverse workforce of new, mid-career, and senior researchers necessary for research on aging.

- Develop and promote flexible training mechanisms that reflect the rapidly changing needs of science and prepare scientists, clinicians, and communicators to work effectively in interdisciplinary team environments.
- Encourage degree-granting institutions to establish and improve programs to identify, recruit, and train scholars for careers in aging research.
- Participate in efforts to recruit, train, and retain biomedical researchers, especially targeting under-represented groups.
- Encourage the training of investigators to translate the findings of basic research into benefits for older people.
- Support the training of geriatricians and other professionals who work with older people.

F-3 Develop clinical resources in support of aging research.

- Support candidate drug evaluation programs, facilities, and related resources, both in animal and clinical studies.
- Develop innovative changes in the design, planning, and implementation of clinical trials in older people.
- Support a robust clinical trials infrastructure to facilitate the translation of laboratory research to human application in age-related diseases, and vice versa. This support will include technical assistance for patient recruitment and retention of older adults in clinical trials.
- Make results of research on patient recruitment strategies widely available to the research community.
- Support studies on the ethical aspects of research, particularly in older populations.

F-4 Develop and distribute research resources.

- Support colonies of animal models on aging, including genetically altered animals. These colonies are necessary for research on aging processes and specific age-related diseases.
- Make cell cultures and tissue, cell, and blood banks available for basic and epidemiological research.
- Create DNA resources for genetic studies on aging.
- Support access to imaging technologies in shared facilities for examining aging biological systems.
- Support computer technologies to record and analyze interdisciplinary research findings on basic biological studies and long-term population-based data, with subject confidentiality protections.

F-5 Disseminate information to the public, scientific community, and health care professionals.

- Rapidly and effectively disseminate the latest advances in geriatric medicine, aging research, and related health data through publications, professional education materials, public service announcements, and videos.
 - *Make available health information and reports of new research findings on the NIA Web site and through the NIA Information Center.*
 - *Maintain and promote the NIA Alzheimer's Disease Education and Referral Center (ADEAR) and the NIH SeniorHealth Web sites.*
- Develop materials for special audiences, including materials for minority investigators

and diverse populations, non-English language materials, and materials for those with limited literacy.

- Support national education campaigns to encourage healthy practices among older adults.
- Support innovative programs to promote positive attitudes toward older people's health needs on the part of health care providers and the public at large.

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